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RELATION OF THE ARIZONA WILD COTTON WEEVIL TO COTTON PLANTING IN THE ARID WEST.[1]

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INTRODUCTION.

With the introduction of cotton culture into Arizona under conditions of irrigation, it was hoped that the establishment of important insect pests could be prevented by quarantines, and this was rendered possible by the complete isolation of the new territory. Recent investigations in Arizona, however, have revealed the presence of a weevil, *Anthonomus grandis thurberiæ*, very nearly identical with the famous Mexican cotton-boll weevil which has proved so disastrous to cotton culture in many parts of the South. This is due to the occurrence, in many of the mountain ranges of the southeastern section of the State, of a wild cotton plant known technically as *Thurberia thespesioides*. This plant, which is so closely related to cotton that some investigators have classed it in the genus Gossypium (the genus of cotton), was found to be the host of a weevil closely related to the cotton-boll weevil, as well as the host of a number of other insects, and it was at once perceived that there was a possibility that these insects might attack cultivated cotton grown near these mountains. Of the various insects found on the wild cotton plant, the weevil is probably the most important, and the present bulletin deals with this species.

HISTORY OF THE WEEVIL.

While the history of the cotton-boll weevil is a familiar subject to almost every one in the infested territory, it is not nearly so well known in the western cotton country, and a brief review of its activities in the United States will help to an understanding of the significance of its presence in Arizona.

The Mexican cotton-boll weevil, *Anthonomus grandis* Boh., came into the United States from Mexico, crossing the Rio Grande at

[1] The investigations on which this paper is based were conducted under the direction of Mr. W. D. Hunter.

Brownsville, Tex., about 1892. Since that time it has advanced steadily northward and eastward until at the present time it is in Texas, Louisiana, Oklahoma, Arkansas, Mississippi, Alabama, and Florida, and the total area infested in 1914 was 312,300 square miles. Estimates made by the Bureau of the Census place the total loss in production of cotton lint in the United States due to the ravages of this species at 10,000,000 bales, or a money loss of $500,000,000. Thus we see the importance of this little beetle of insignificant appearance in the area now infested.

Extended studies have been made by the Department of Agriculture and also by the various State offices in the attempt to reduce the damage done by the species. It has proven one of the most difficult insects to combat, owing largely to its habit of feeding at all times on inner plant tissue and so making the use of poisons practically worthless. The most effective methods of reducing damage which have been developed are principally cultural.

During the summer and fall of 1913 the writer experimented with the Arizona wild cotton weevil and the Texas cotton weevil at Victoria, Tex., crossbreeding them and testing the adaptation of the Arizona form to conditions of cultivated cotton in the South. In April, 1914, the work was transferred to a ranch near Tucson, Ariz., and was continued until the middle of November. This bulletin is a partial result of these studies.

Although the Thurberia plant has been studied botanically for some years, owing to its close relation to cotton, economic interest from an entomological standpoint was first aroused early in 1913, when Mr. O. F. Cook, of the Department of Agriculture, announced the discovery of the weevil breeding in the bolls of this plant in Arizona. This announcement was at once followed by a study of the exact taxonomic status of the weevil, its distribution, habits, and probable economic importance. It was soon found to be not identical with the cotton-boll weevil of the South, but so closely related that the two forms would interbreed readily. It was then described as a variety of *Anthonomus grandis* by Mr. W. Dwight Pierce, of this bureau, and given the varietal name *thurberiæ*. Further investigations lead to the belief that the two types are geographical and environmental varieties arising from a common ancestral form which was probably native to some point in southern or central Mexico. The two forms have probably spread northward along separate lines of distribution in the course of time and have acquired slight differences in structure and habit.

These differences in structure of the adult beetles are so slight that they are not apparent to the untrained eye and the descriptions used in this paper are applicable to either type.

DISTRIBUTION.

The discovery that the weevil breeds on Thurberia furnished the first intimation that it lives on any plant other than those of the genus Gossypium, though the writer has since demonstrated that it is able to develop on some other closely related malvaceous plants. However, it is not likely that this occurs in nature under normal conditions, and there is no reason for believing that the weevil feeds upon any plant other than Thurberia in the mountains. Consequently a study of the distribution and habitat of Thurberia is second in importance only to that of the weevil itself. While our knowledge of this point is by no means complete, considerable information has been gathered in the course of a number of explorational expeditions, and we possess a fair general idea of the conditions.

In Arizona Thurberia is known to occur in the Santa Catalina, Santa Rita, Tanque Verde, Rincon, Mule Pass, Huachuca, Chiricahua, Superstition, Bradshaw, Dos Cabezos, and Dragoon Mountains; at Globe, and in Fish Creek Canyon of the Salt River Valley. In Mexico it has been recorded from Guadalajara, southwestern Chihuahua, and a number of localities in eastern Sonora. The weevils have been found only in the Santa Catalina, Rincon, Santa Rita, Tanque Verde, and Dos Cabezos Mountains. Of these ranges the first four adjoin the Santa Cruz Valley, in which Tucson is located, and the last is near Bowie. From these data it is seen that the plant is rather generally distributed throughout the southeastern part of Arizona and that the weevil infestation, so far as is known at present, is more or less concentrated around Tucson. Of course, additional explorational work will undoubtedly disclose new localities where both plant and weevil are present.

Because of the apparent concentration of the weevils around Tucson it was believed that this was the point of greatest danger of infestation of the cultivated cotton, and the economic investigations were conducted there. While the largest area of cotton cultivation in the State is in the Salt River Valley in the vicinity of Phoenix, the weevil has not been found near there, and the Santa Cruz Valley seemed in more immediate danger.

THE THURBERIA PLANT.

Many of the habits of the weevil are directly dependent upon the characteristics of the Thurberia plant, and the habitat and activities of this plant have been carefully observed. It is found at altitudes ranging from a little over 2,000 feet to 7,000 feet. While colonies are frequently found high on the sides of the canyons and on the ridges, the most common habitat in the mountains around Tucson is in the beds of the canyons and small washes. Here it grows among the

rocks and on the small islands in the bed of the wash wherever there is sufficient moisture and enough protection from the force of the current in flood seasons. (Pl. I, fig. 1.) Many of the small washes down near the base of the mountains, not large enough to deserve the title of canyon, support great numbers of the plants. Following down from such situations the plant is found in the arroyos extending out through the mesa and often at quite a distance from the mountain range proper. (Pl. I, fig. 2.) The economic significance of this lower distribution will be discussed later in the present paper. In the ranges where the weevils have been found their distribution is very nearly as wide as that of the plant.

The Thurberia plant is a large, woody perennial and frequently reaches a height of over 10 feet, though the plants ordinarily met are from 4 to 6 feet tall. (Pl. II.) The stem is very tough after the first year's growth and supports an abundance of wide-spreading branches. The close relationship of the plant to cotton is quite apparent, and particularly so during the flowering period. A great number of buds (corresponding to the "square" of cotton) are produced. After blooming the square forms a small boll not unlike that of cultivated cotton, varying from one-half to three-fourths of an inch in length when fully developed. When these ripen and dry they open and expose the three to five cells, each containing a double row of angular, blackish seeds covered with a fine pubescence. More or less fiber resembling that of cotton is present in nearly every boll. It is in this boll that the weevil breeds.

The flowering season of Thurberia depends upon the location, moisture, altitude, and various other conditions. In practically all localities in the mountains around Tucson the leaves appear in April or May. In the lower, moist spots the plants bear fruit buds almost immediately and many fruit prolifically at this time. After two or three weeks of this flowering the buds cease to appear and there is a quiescent period during which the fruit ripens. Then another crop of buds appears and the same course is repeated. In this manner as many as four crops have been noted on a few plants during the season of 1914 and many bore three. This condition was found only at altitudes below 3,000 feet. Many plants midway up the mountains bore a partial crop in July and then had a heavy one in August and September, while others at much the same altitude had only the latter crop. Throughout the entire upper distribution (above 4,500 feet) the plants grew luxuriantly all summer, but not a single fruiting bud was produced until August. Then an enormous crop appeared, and flowering continued until the latter part of September. This flowering evidently varies in the same situations in the different seasons according to the amount of rainfall.

FIG. 1.—HABITAT OF THE WILD COTTON WEEVIL AND ITS HOST PLANT.

Basin of the Milagroso Canyon in the Santa Catalina Mountains, Ariz. This is an ideal location for *Thurberia thespesioides*, the wild host plant of *Anthonomus grandis* var. *thurberiæ*. Two large plants may be seen near the right-hand margin of the photograph. (Original.)

FIG. 2.—THE WILD COTTON WEEVIL AND ITS HOST PLANT IN THE LOWER RANGES.

Habitat of *Thurberia thespesioides* and the wild cotton weevil in the lower ranges. This view was taken in the Agua Caliente Arroyo, Ariz., about 100 yards below the plant shown in Plate II, figure 1. (Original.)

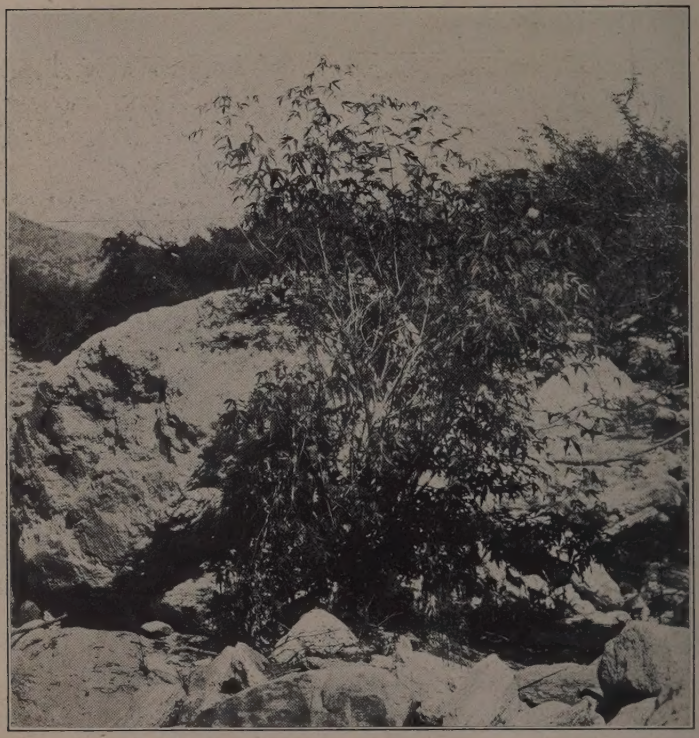

FIG. 1.—DISPERSION OF THE WILD COTTON WEEVIL.

Typical location of Thurberia plant, below rock, in Agua Caliente Arroyo, Ariz., about 1½ miles from the mouth of the canyon. (Original.)

FIG. 2.—THURBERIA THESPESIOIDES, HOST PLANT OF THE WILD COTTON WEEVIL.

Growth of Thurberia at Agua Caliente Ranch, Ariz., under cultivated conditions. This is one season's growth from seed. (Original.)

INJURY BY BOLL WEEVIL TO SQUARES.

a, Bloom checked by attacks of larva; *b*, square opened, showing grown larva; *c*, square opened, showing pupa; *d*, dwarfed boll opened, showing one larva and two pupæ; *e*, weevil escaping from square; *f*, emergence hole of adult in square. (From Hunter and Pierce.)

INJURY BY BOLL WEEVIL TO BOLLS.

a, Three larvæ in boll; *b*, emergence hole in dry unopened boll; *c*, two larvæ in boll; *d*, weevils puncturing boll; *e*, opened boll, with two locks injured by weevil; *f*, large bolls severely punctured. (From Hunter and Pierce.)

LIFE HISTORY OF THE WEEVIL ON COTTON IN THE SOUTH.

In order to understand the life cycle of the weevil it is well to review briefly its action on cultivated cotton in the Southern States. The female bores a small cavity in the square or boll and deposits the egg in this, sealing the opening with a small gelatinous scale. The egg hatches in a few days and the larva or "worm" feeds upon the inner plant tissue. (Pls. III and IV.) After a period varying from a few days to about two weeks the larva transforms to the pupa, a quiescent stage in which the first resemblance to the adult weevil is shown. After a few days in this stage the pupa sheds its skin and becomes the adult weevil, which quickly leaves the square or boll in which the immature stages were passed and is soon ready to start the cycle again. These immature stages usually require from two to three weeks, although they vary with the temperature, food, and other environmental factors. Starting in May or June and continuing until September or October, as is the case in the cotton States, it is quite possible for six or eight generations to be produced in a single season, and as most females deposit from 100 to 300 eggs or more the progeny of a single pair may reach enormous numbers in the course of a season. In fact, it has been conservatively estimated that the annual progeny of a single pair of hibernated weevils would reach 3,089,520.

LIFE HISTORY OF THE WEEVIL ON THURBERIA.

While the details of the life cycle of the Thurberia weevil in the mountains in Arizona are much the same as those of the cotton weevil in the South, there are a number of important differences. Among them is the mode of hibernation, or manner in which the winter is passed.

Adults of the last fall generation of the cotton weevil usually emerge from the squares or bolls in which they breed and seek shelter in all kinds of situations offering protection near the cotton fields. A great variety of crevices, trash, moss, and other shelters are used for this purpose. The Thurberia weevil, on the other hand, fails to emerge in the fall, but remains sealed up in a cell formed in the midst of the seeds in the boll and passes the winter in this condition. Then in the spring, instead of becoming active with the first warm weather, as the cotton weevil does, the greater number of them remain sealed in the cell until the rains late in the summer, many not emerging until August. This is simply a case of prolonging the period of hibernation into one of aestivation, a habit often observed among species living in arid regions. In order to know when to expect the weevils, a number of experiments have been conducted in the laboratory and close observations have been made in the

field to determine just what conditions are necessary to cause the emergence of the adult. By combining the records secured under both natural and artificial conditions it seems quite possible to determine more or less definitely under what conditions the weevils emerge, and by studying the seasonal climatology of the region inhabited by the weevils we may know when to expect the appearance of the adults.

During the winter the boll containing the weevil cell passes through a continual process of partial disintegration caused by alternate moistening and drying. Following this, more or less moistening of the weevil cell is necessary to allow emergence in most cases, although an occasional individual emerges from time to time from the poorly constructed cells. With this as a basis we need but study the distribution of the rainfall through the spring and summer months in order to determine when emergence of the weevils is to be expected. The temperature is undoubtedly usually high enough by the 1st of April, and the emergence depends almost entirely upon the rainfall from this time onward. April, May, and June are the dry months in this locality, but a study of the seasonal precipitation for a number of years shows that even in the driest of years there are some few light rains in this period and usually some precipitation each month. So we may expect a scattering emergence of the weevil throughout the spring and summer months, the extent of this emergence depending upon the amount of the precipitation, and finally culminating in the almost complete emergence following the heavy rains of July and August.

This very late emergence of the Thurberia weevils shortens the breeding period in the greater part of the mountains to not over two generations annually instead of the six to eight of the cotton weevils.

It should be remembered that while this habit of hibernation and aestivation prevails in nature now, it is by no means certain that it will be adhered to by the weevils in case they attack cultivated cotton in the valley, but it appears likely to continue for some time at least. Weevils reared on cotton in Arizona showed a very definite adherence to this cell hibernation habit when bred in the bolls, but it seems that they will emerge from the squares. Since the females greatly prefer bolls for oviposition it seems probable that nearly all of the late-season breeding will be in these, and consequently little emergence in the fall should be expected. In case the weevil adheres to this cell hibernation habit the control should be quite simple, entailing only the winter destruction of the plants and hibernating weevils.

Most of the breeding on the Thurberia plant seems to be in the bolls, and under normal conditions the bolls from one-third to three-fourths grown are selected for egg deposition. The eggs are placed

in the punctures just as in the case of cotton weevils and the openings are sealed in the usual way. The larva feeds upon the immature seeds and develops in much the same manner and time as the cotton weevil.

DESCRIPTION OF STAGES OF THE WEEVIL.

The egg.—The egg of the weevil is usually elliptical in shape and is of a pearly white color. It is slightly less than 1 millimeter (one twenty-fifth of an inch) in length and is deposited by the female at the bottom of a small opening, usually near the base of the bud or boll, and deep among the plant tissues.

The larva.—Immediately after hatching the young larva is a white legless grub only slightly longer than the egg itself. It feeds entirely upon the inner tissue of the bud or boll and enlarges the cavity as it grows. It soon assumes a ventrally curved, crescentic form and when fully developed averages about 1 centimeter (two-fifths of an inch) in length across the curve.

The pupa.—The pupa is either pearly or creamy white and is very delicate. The form of the legs, beak, and wings may be observed in this stage.

The adult.—When the weevil first transforms from the pupa to the adult it is quite soft, weak, and very light in color. It hardens and darkens in the course of a day or two and is then fully mature. It is a stout, subovate beetle, with a long snout or proboscis. The color varies from light golden brown to very nearly black, according to the age and condition of the individual. When newly emerged it is clothed with light-colored scales, but these frequently rub off in the course of the activities of the weevil, and the darker color of the body predominates.

The size of the adult is also exceedingly variable and is determined largely by the food supply of the larva. In length adults vary from 2.5 to 7 millimeters (one-tenth to one-fourth of an inch).

NATURE OF DAMAGE TO COTTON.

The actual damage of the weevil to cultivated cotton consists in the direct attack upon both the buds and bolls. The adults feed by making punctures with their long beaks deep into the tissues of these, and several such punctures will prevent a bud from blooming or will destroy the lock of the boll in which they are located. By far the greater part of the injury, however, is due to the work of the larval or "worm" stage. The female weevil deposits the egg in the bud or boll and the one larva completely destroys the contents of the bud or lock in which it is located. Within a few days after the deposition of the egg the square "flares." That is, the involucral bracts or greenish leaves, with which the bud is normally

covered, open back flat in a very abnormal position and become pale, sickly yellow. Such an injured square is very conspicuous on a plant in the field and is usually the first indication noted of the presence of weevils. After a few days the square falls to the ground in nearly all varieties of cotton, and in heavily infested fields in the South it is a very common sight to see great numbers of these squares scattered beneath the plants. With the bolls the injury is not so easily noted, since they do not fall unless very heavily infested, but the punctures are readily found by a careful examination, and frequently the form of the boll is distorted. (Pls. III and IV.)

FOOD PREFERENCES OF THE ARIZONA WEEVILS.

A number of tests have been made to determine whether or not the Thurberia weevil displays any preference for either Thurberia or cultivated cotton. These experiments were conducted both in the laboratory and in large cages in the field, and great care was taken to eliminate all factors from the choice other than the actual attraction of the plants. It was found that individuals removed from hibernation cells and offered both plants displayed what seemed to be only the slightest choice in favor of Thurberia, and this disappeared after a few days' feeding. Weevils removed from the cells and fed only upon Thurberia for a few days and then offered a choice at first displayed a marked preference for Thurberia. After a few days' feeding in the presence of both plants this preference gradually disappeared and cotton was as much eaten as Thurberia. Weevils fed only upon cotton for a few days after removal from the cells would at first display a choice in favor of cotton, but this disappeared in the same manner. From these experiments, and also from observations made in the field in 1914, it seems safe to conclude that the weevils have very little inherent preference for either plant and that neither plant has the power to attract them away from the other.

THE TRANSFER TO COTTON.

The transfer of the weevil to cultivated cotton may be accomplished in two ways, i. e., by flight or by water. While it is of course impossible to determine the exact extent of the flight of these weevils, either in distance or frequency, all available evidence seems to indicate that this means is likely to be of little importance in the primary spread of the weevils. It seems that as long as there is an abundance of food at hand the weevils will fly very little, but in case of food shortage they fly readily. On the other hand, the habits and present distribution of the weevil make the species particularly adapted to dispersion by floods. Most of the Thurberia plants grow either directly in the wash of a canyon or arroyo or where the surface drainage is directly into such a wash. Many of the bolls containing

the hibernating weevils in their cells fall to the ground during the months of the winter, spring, and early summer, and because of their size and shape they are well adapted for being carried great distances out through the foothills on to the plains by the floods that occur every season. Here they are deposited by the water, and, the cells having been sufficiently moistened, the weevils emerge. Thence they will fly in search of food, and if they have been carried out into the zone of cotton the danger of infestation is quite apparent. It is in this manner that the infestation is most likely to take place; hence the importance of a study of the surface drainage carrying the water from the infested mountains into the various rivers.

In this connection the distribution of the plants through the lower arroyos is especially important. In many localities these now support weevils and so are a constant menace to cotton, while even where the weevils are not now present they are always likely to serve as stepping stones in the downward movement of the weevil maintained by the floods.

In the course of the investigations several small plats of cotton were planted, comprising in all a little over one-fourth of an acre. On the 30th of July the writer noted several flared squares in this cotton. Examination showed them to contain weevil punctures, and a careful survey of the entire plat revealed the fact that a light infestation of weevils was present. During the remainder of the season all infested squares and bolls noted were collected and a few adult weevils were captured on the cotton. The infestation never became heavy, but it was quite evident that some 10 or 15 weevils arrived at the plat at different times during the next two months. This is of course conclusive proof of the transfer from wild to cultivated cotton.

Early in the season, when a survey of the countryside was made, it was decided that the ranch where this cotton was planted was a logical point for infestation by the boll weevil. It is located at the junction of the arroyos from two large canyons, and consequently receives a concentration of the water flow from these two canyons and all intermediate territory. The Thurberia plant is quite common throughout this drainage system and extends down to within a fourth of a mile of the ranch, although the nearest plants found infested with weevils are slightly farther away. The writer feels that in the course of the weevil collections during the early summer every weevil within at least a mile of the ranch was gathered; the infestation must therefore have been due to weevils brought down by the floods from some distance above. In fact the week before the infestation was first noted there had been a number of rains in this territory, and on one occasion the canyons had poured water down into the washes and out as far as the ranch. These arroyos are nearly

all very rapid in descent near the mountains, and very rocky, so that comparatively little of the water seeps into the ground in this part of the journey and the force of the current scours the channel clean. Just above the ranch the character of the stream bed changes and it becomes wide and sandy. Here the water seeps rapidly and practically every flood of the present season was able to reach but little below the ranch in this sand. Hence the Thurberia bolls containing weevils may be expected to pass through the rapid part of the stream and be deposited on the sand where the flow stops near the ranch. It was probably some such procedure as this which caused the infestation of the experimental cotton during the season of 1914, and the possibility of future infestation will always be present.

PROSPECTS.

From the various observations reported herein it seems quite evident that it is only a matter of time until the weevil will appear on the cotton cultivated near Tucson. The territory best adapted for the cultivation of cotton and that upon which it seems most likely to be raised is nearly all within easy reach of the floods from weevil-infested territory. While it is obviously impossible to state that the infestation will appear at a certain point, there are many places more liable to infestation than others. Such a location has been described at the ranch where the cotton was infested and a number of similar ones occur along the mountain slopes. The fact that the experimental cotton was infested during 1914 demonstrated the importance of such a situation, but, on the other hand, it is by no means certain that the infestation would be repeated each season. However, the movement of the weevils out into the plains which takes place every year must sooner or later result in the infestation of cultivated cotton in the valley. These weevils which are washed into the field can do comparatively little damage themselves, but the result to be feared is that their progeny will become established in the valley, will winter there, and will become more and more adapted to injuring cultivated cotton.

Another point which is likely to be of prime importance in the transfer of the weevil is the practice among many ranchers of using these floods for irrigating their land. A ditch is opened from the arroyo and in time of flood the water is diverted into this ditch and conveyed to the cultivated land. Agua Caliente arroyo is tapped in this manner near one corner of the Agua Caliente ranch and the water is led off to a ranch on the west side of the stream bed. Soldier's Canyon arroyo is tapped in the same way about one-half mile from the mouth of the canyon and the water is carried off to the southwest through several homesteads. The water from Sabino and Bear Canyons is used in the same way near the junction of the two arroyos. Since these

ditches all leave the washes at points very close to Thurberia plants and in some cases among weevil-infested plants, it is quite easy to see the probable importance of this method of irrigation in introducing weevils and weevil-infested bolls directly into the fields.

It is also the custom of a number of ranchers down in the river valleys to allow their land to be flooded whenever possible in order to secure the soil deposit as well as moisture. While these places are farther from weevil sources it is quite possible for weevils to be introduced in this manner.

At present the cotton cultivated near Tucson is practically all northwest of the city near the Santa Cruz and Rillito Rivers. The nearest mountains in which we have found the weevils are the Santa Catalinas, and at the western end these drain more or less directly into the valley now cultivated. Pima Canyon and the small washes adjoining it drain slightly west of south into the Rillito and thence directly into cotton land. The northwestern slope at this end of the range, including Montrose and Romero Canyons, drains into the Canada del Oro, and this water flows southwest into very nearly the same territory. The drainage of the entire southern slope of the Catalina Range is thickly infested with the weevils, which frequently extend along the "washes" very nearly to the Rillito. There is no doubt that every season a number of weevils are washed down into this country, and any cotton cultivated in this part of the Rillito Valley will be in constant danger of infestation. On the east the Tanque Verde Mountains supply a stock of weevils carried down toward the village of Tanque Verde, while southeast of Tucson, near Vail and Irene, the headwaters of the Pantano are furnished with weevils from the ends of the Rincon and Santa Rita Ranges. South of Tucson in the valley of the Santa Cruz the drainage from the northwestern slopes of the Santa Ritas contains weevils and Thurberia plants well down toward the river itself. West of Tucson there seems to be very little danger other than that from the end of the Catalinas, as the Tucson and other ranges here seem unable to support the plant.

Under the existing circumstances there seems to be no measure which can be taken to prevent the introduction of the weevil into cotton fields, but a close watch should be continued at all times in order that an attempt may be made to control them as soon as they appear. Planters should maintain a careful watch for either flared or fallen squares and bolls in the field and examine them for either the feeding punctures or larvæ of the weevils. This observation should be especially close in fields or parts of fields adjacent to water courses carrying drainage from situations such as those described as normal for Thurberia.

At the present stage of the investigations it is impossible to predict just what the extent of the damage by the weevils will be when

they attack cotton. Many of the habits of the Thurberia weevil are adapted to the activities of these plants and to the higher altitudes at which they live, and it is questionable just how readily and to what extent it will adapt itself to cotton. But since the species has shown such great adaptiveness in the Southern States, it is to be feared that the Arizona form will do the same. At any rate, it is an ever-present menace to cotton cultivation in the Santa Cruz Valley and should be watched most carefully. It is quite probable that with a more intimate knowledge of the extent of the weevil distribution in the State it will be possible to establish local quarantines of seed-cotton shipments which will at least keep the weevils out of the localities which do not have the species present in nature. In the Southern States cotton cultivation is of course very general and there the weevil advances each season by flying, but in Arizona, where the different areas suitable for cultivation are separated by considerable stretches of mountainous country, such a means of dispersion would only be possible within very limited areas. Consequently it should be possible to keep the weevil entirely out of areas not within range of direct infestation from nature.

In addition to the watch for infestation by native weevils, the danger of importation of the weevil from the Southern States should be remembered, and all efforts should be made to validate the quarantine against this variety.

SUMMARY.

1. A weevil very closely related to the Mexican cotton-boll weevil exists on a wild cotton plant in some of the mountains of southeastern Arizona.

2. The species seems to be particularly concentrated in the ranges surrounding Tucson.

3. This weevil may transfer its attack from the wild cotton plant to the cultivated cotton in the Santa Cruz and Rillito Valleys at an early date.

4. Its present habits are such that it would not injure cotton greatly, but these habits will probably be changed to a certain extent and more injurious ones acquired.

5. The present habits render it quite probable that the control of the Arizona form will be a very different problem from that of the cotton weevil and more easily solved.

6. A careful watch should be maintained for the first appearance of the weevil on cultivated cotton in order that it may be combated successfully.

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